

Dynamics of emerald ash borer infestation, ash mortality, succession, and invasive plant species in infested forest ecosystems: What we've learned in Michigan and Ohio

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Emerald ash borer (EAB) (*Agrilus planipennis*), an introduced insect pest, has killed millions of ash trees in the Midwest and is spreading rapidly. The effects of EAB on forest ecosystems are being studied through a collaborative research program between the US Forest Service and the Ohio State University. We are monitoring decline and mortality of >4500 ash trees and saplings using a user-friendly crown health rating system in over 250 monitoring plots in forests in Ohio and Michigan, representing a gradient of EAB infestation duration. We are also monitoring EAB populations, changes in understory light availability, responses of both native and invasive plant species, changes in species composition and forest structure, and effects on other organisms and ecosystem processes. Yearly monitoring began in 2004 and is continuing. The plots are located in forest stands representing different ages and habitat types to include all five ash tree species native to the region, including black ash (*Fraxinus nigra*).

Data from these monitoring plots show that an infested stand of ash trees can progress from healthy to nearly complete mortality within six years. In areas of southeast Michigan and northwest Ohio where EAB has been present the longest, nearly all of the ash is dead. In other areas of Ohio and Michigan that have only been infested a few years, some ash trees are healthy, some are declining, and some are dead. A small percentage of ash trees (approx. 1 in 1000) continue to look healthy in forested areas where the rest of the ash is dead. It is too early to tell whether these "lingering" ash trees will ultimately survive or die.

In Ohio sites, 2008 was a mast year for ash seed production, resulting in newly germinated ash seedling densities >10,000 per acre in 2009. In sites where ash trees had reached nearly complete mortality of ash in 2008, there were very few new ash seedlings in 2009, but established seedlings a few years old were common. It is too

early to tell whether this final cohort of ash will be killed by EAB when it reaches susceptible size. We have observed EAB exit holes in 1 in (2.5 cm) diameter ash saplings.

Data from purple panel traps suggests that EAB populations begin small, rapidly increase and peak, and then crash but persist at low densities after eliminating their food source. It is too early to tell whether EAB will continue to persist in these areas or die out.

Forest canopy gaps, formed by dying ash trees, allow increased light to the understory in stands without a well-developed midstory. The increased light affects both native and invasive plants in these ecosystems. Of the 14 species of invasive plants found in our monitoring plots, those that are most often associated with ash swamps are reed canary grass (*Phalaris arundinacea*) and common buckthorn (*Rhamnus cathartica*).